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## Estimating nitrogen losses -- early spring 2007

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## Estimating nitrogen losses -- early spring 2007

by John Sawyer, Department of Agronomy

One method to judge nitrogen (N) loss is to calculate an estimate. Predicting the exact amount is quite difficult as many factors affect losses. However, estimates can provide guidance for supplemental N applications. While the rainfall this spring has been substantial, it arrived early. This should help moderate loss compared to the same situation occurring in late spring or early summer. In the early spring, soils are colder, so conversion to nitrate and denitrification is slowed. However, having two large rainfall events means that some soils were saturated over a prolonged period. This increases the chance for loss.

### Research Measurement of Nitrate Loss

Research conducted in Illinois (reported in the 1993 Iowa State University Integrated Crop Management Conference proceedings, pp. 75-89, and in Torbert et al., 1993, "Short-term excess water impact on corn yield and nitrogen recovery," *Journal of Production Agriculture* 6:337-344) indicated approximately 4 to 5 percent loss of nitrate-N by denitrification per day that soils were saturated. An all-nitrate fertilizer was applied when corn was in the V1 to V3 growth stage. Soils were brought to field capacity and then an excess 4 inches of water (above ambient rainfall) was applied by irrigation evenly over a 3-day period (which maintained saturated soils for 3 to 4 days on the heavier textured soils) or an excess of 6 inches of water was applied over an 8-day period (which saturated soils for an additional 3 to 4 days). The excess water application resulted in loss of 60 to 70 lb N/acre on silt loam and clay loam soils, due to denitrification loss. On a very coarse-textured, sandy soil, virtually all nitrate-N was moved out of the root zone by leaching. On the heavier textured soils, an addition of 50 lb N/acre after the excess water application was sufficient to increase corn yields to approximately the same level where no excess water was applied. This was not the case on the sandy soil because considerably more N was due to leaching.

### Estimating Nitrate Loss

According to research at the University of Nebraska, the estimated denitrification loss of nitrate when the soil temperature is 55 to 60 °F is 10 percent when soil is saturated for 5 days and 25 percent when saturated for 10 days (2 to 2.5% loss per day). Loss increases with warmer soils. Research conducted in Illinois with late May to early June excess application of water on silt loam and clay loam soils indicated approximately 4 to 5 percent

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loss of nitrate present per day that soils were saturated.

To estimate N loss, first estimate the amount of ammonium converted to nitrate-N. By early May, with warmer than normal temperatures since application, one might assume fall anhydrous ammonia and fall manure ammonium to be 80-100 percent converted to nitrate and with early April preplant N application, approximately 50 percent converted to nitrate. Less conversion to nitrate would occur with use of a nitrification inhibitor and a cooler period. Recent ammonium applications (within the last two weeks) would still be predominantly in the ammonium form, especially for anhydrous ammonia. Recent application of nitrate-containing fertilizers would result in more nitrate present during the same time period. Urea-ammonium nitrate solutions (28 or 32% UAN) contain one-quarter nitrate-N. Second, estimate the percentage of nitrate-N loss as described in the research above. The amount of N loss is calculated from these two estimates.

## Example

The following might be an example of a situation with a recent spring application of UAN solution and the wet conditions encountered in late April or early May this year.

If half of a 120 lb N application is converted to nitrate, and soils were then saturated for 10 days when cool, the N loss estimate would be  $(120 \text{ lb N per acre} \times 50\% \text{ nitrate}/100) \times (2.5\% \text{ per day}/100) \times (10 \text{ days}) = 15 \text{ lb N per acre}$ .

If all of a fall ammonia or early spring UAN application is converted to nitrate and soils were saturated for 15 days when warm, the N loss estimate would be  $(120 \text{ lb N per acre} \times 100\% \text{ nitrate}/100) \times (5\% \text{ per day}/100) \times (15 \text{ days}) = 90 \text{ lb N per acre}$ .

Variation of lower or higher losses could easily occur depending on warmer or cooler conditions and more or less time from N application to wet conditions. The same will occur for different landscape positions and soils. With very coarse-textured/sandy soils, significant rainfall events (4 to 6 inches or more) in addition to already moist soils could easily result in all nitrate leaching out of the crop rooting zone.

*John Sawyer is an associate professor with research and extension responsibilities in soil fertility and nutrient management.*

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